Light and Lighting

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Can You Tell When The Lighting is Better?

YOU may prove that the foot-candles are increased, that the brightness (and consequent glare) from lighting fittings has been diminished, that the diffusion is more complete (and the shadow conditions presumably more satisfactory).

But can you tell that the lighting is *better* in the sense that those who use it are getting benefit?

This was one of the knotty points raised in the discussion of Mr. Stuart D. Lay's recent paper before the I.E.S. in Newcastle. It is one that illuminating engineers would do well to study.

We can get some indications from records of accidents or of quality and output of work performed—but such researches take a long time and it is difficult to separate extraneous factors. Certain physiological and ocular tests have been devised, but they are difficult to apply, and are not universally accepted. We have sought in vain for a ready means of assessing effects of glare.

It all boils down to this. We have no yard stick by which to measure *the effect* of lighting—yet this is the criterion by which lighting installations should stand or fall.

Fuel Economy and Access of Daylight

As was pretty generally anticipated, the Fuel Rationing Scheme, intended to come into operation on the first of this month, has been deferred. Ultimately it may possibly reappear in a simplified form. In the meantime consumers are being urged to economise in artificial lighting. On the underground railways increasing dimness is evident, and by a recent Order the use of gas or electric light in shop windows is prohibited. In most cases diminution in artificial lighting has to be paid for in some form, by greater fatigue, reduced efficiency, increased discomfort and inconvenience. Yet all the time there is proceeding one obvious and positive waste—the use of artificial light in factories from which daylight is permanently excluded by "black-out" precautions. Allusion was made to the grave drawbacks attending the exclusion of daylight in the annual reports of the Chief Inspector of Factories for 1939 and 1940 and in the familiar "Fifth Report" of the Departmental Committee on Lighting in Factories. Consumers were then encouraged to remedy these defects. and at one time a substantial improvement was achieved. Unfortunately, however, experience during the period of serious air-raids seems to have checked this tendency, and at the present moment the aggregate consumption of gas and electricity during daylight hours must be very considerable. Attention is drawn to this fact in a report issued by the "Committee Advocating Daylight in Factories," which quotes from the publications mentioned above and from Mr. H. C. Weston's recent I.E.S. paper in order to illustrate the prejudicial effect of complete black-out on health and output. Two main factors, it is stated, are responsible for present conditions: (1) the elimination of roof lights from new designs of Government factories, and (2) the withdrawal of financial support for schemes of mechanical shutters. A third factor—difficulty in getting material for adjustable shutters and similar devices—is doubtless also operative at the present time. In view of the urgency of the fuel problem, it might be well for the authorities to review the present situation and to consider whether they could not do more to achieve economy by making better use of the abundant natural light available, rather than curtailing the use of artificial light in situations where no alternative exists.

Advertisement Lighting (Restriction) Order

Since the outbreak of war it has, of course, been forbidden to display anything in the nature of advertisement lighting after dark. The Advertisement Lighting (Restriction) Order 19, dated May 11, 1942, which came into force on May 18, also forbids such lighting during the daytime. The text of the Order is as follows:—

"No person shall use any lighting fitting or other appliance whereby there is consumed any electricity, gas or other light-producing substance, for the purpose of advertisement lighting inside any premises, unless it is proved that:—

"(i.) the fitting or other appliance is reasonably necessary for illuminating the general interior of the premises for the purpose of serving the public, and is still being so used only during such time as the said premises are open to the public; or

"(ii.) such user is only such display of light as is described in Part IV. of the Lighting (Restriction) Order, 1940."

There was at first some little uncertainty as to whether the Order was intended to eliminate completely shop-window lighting. We gather that this is the intention, and in fact, since the Order came into being, such lighting has practically ceased. There are, however, more debatable forms of lighting, for example, the illumination of showcases. Is it to be held that this is essentially "display lighting"? Or is it necessary for the purpose of serving the public, if they cannot see the contents of the case properly without it? On this point there is, at the moment of writing, more diversity of view.

The condition (ii.) above presumably refers to the use of signs of low brightness to indicate the purpose of a shop, still permitted even during the black-out. Although Part IV. also permitted the use of subdued window lighting by means of cabinets, and of display signs of low brightness, this permission was withdrawn subsequently. In any case the low order of brightness allowed could be of no value during daylight hours.

The object of the Order is evident. It is directed towards achieving economy in gas and electricity, and hence saving in fuel. During the bright summer weather which we are now experiencing the elimination of shop-window lighting need not be too severely felt. If, however, it is continued during the dark winter months it will doubtless be a great deprivation.

Public Lighting in War-Time

The Association of Public Lighting Engineers have done a useful service in presenting, with their Annual Report (1942), tabulated data on public lighting, including war-time street lighting throughout Great Britain. These data have now been amplified by the inclusion of information for areas which are not under the control of members of the A.P.L.E. Although the value of war-time street lighting is admitted, and many thousands of miles of streets have been furnished with such lighting, the impression made by the tables is that very much remains to be done. With some notable exceptions the greater part of the total mileage of streets is left unlighted. A readable foreword by the president (Mr. E. J. Stewart) reviews the problems of the public lighting engineer in these abnormal times—in many cases very formidable by reason of depleted staff and other handicaps. One important point emphasised by Mr. Stewart is the effect of neglect on the performance of war-time street lighting fittings, which must frequently yield very much less even than the 0.0002 ft.-c. nominally available at pavement level. As usual, the Report is accompanied by a list of members and by a complete record of papers read from 1923 to 1939. Anything in the nature of an annual conference had naturally to be abandoned with the outbreak of war. Indeed, increasing difficulty in travelling led to the cessation, in 1941, even of the simplified annual meeting proposed as a substitute.

I.E.S. Annual General Meeting

An Encouraging Record of Progress

As promised, we now deal a little more fully with the I.E.S. annual general meeting, to which allusion was made in our last issue.

If will be recalled that the annual meeting took place in the lecture theatre of the Institution of Mechanical Engineers on May 12, and was followed by a sessional meeting at which Mr. G. H. Wilson's address on "Street Lighting, Past, Present, and Future," was delivered (see p. 71).

Growth of Membership

The report of the Council, briefly summarised by the President, again reveals encouraging progress. In all about 250 new applications for membership have been received during the past session, and about fifty meetings have been held —certainly a remarkable sign of vitality under war conditions. The number of Fellows elected up to date in the Report is ninety-six, rather less than 10 per cent. of the total membership of the Society, which now exceeds 1,100. The President, commenting on this rapid growth, said that he looked forward to the time when the membership would reach the 2,000 mark. The growth in membership has been reflected in the income of the Society, which has passed the £2,000 mark for the first time in its existence. As might be anticipated, however, this increase is largely offset by expenditure on new activities.

Centres and Groups

A feature has been the development of the Centres, of which there are now five in operation, and the Groups, now six in number, and mostly formed during the past session. Ultimately there will doubtless be a much greater number of Centres than at present. Therefore, a third stage, the division of Great Britain into eight regional areas, each having its own area committee, to supervise the activities of a number of Centres, is visualised. Attention was drawn by the President to the useful work done by the North Midland and North-Western Centres on textile lighting. It is hoped that other Centres will initiate researches on the lighting of special industries in their localities.

I.E.S. Code.

Work on A.R.P. lighting, which played such an important part in the Society's activities during the initial period of the war, is now to a great extent stabilised. Attention is, however, drawn to the enhanced status of the I.E.S. Code, which has now been adopted by the Ministry of Supply, the Admiralty, and the Ministry of Aircraft Production in applying the Factories (Standards of Lighting) Regulations (1941). A revised version of this Code has recently been issued.

Lighting Reconstruction

The part to be played by lighting in connection with post-war reconstruction is being studied by a number of I.E.S. committees. A series of informative pamphlets is being prepared by one of these committees. Another is exploring legislation bearing on lighting and contacts are being established with Government Committees, departments and kindred bodies interested in these problems.

The New President

It was announced that no independent nominations for officers and members of Council have been received. The Council's nominations, therefore, become effective, and the new President will be Mr. R. O. Ackerley, who is acting as chairman of the Lighting Reconstruction Committee. Mr. E. Stroud has been added to the list of vice-presidents. Grateful acknowledgment was made of the services during the past three years of Mr. E. W. Murray, as honorary treasurer. He is to be succeeded by Mr. H. C. Weston.

In presenting these data the President mentioned one contemplated change in future procedure—namely, that the report of the Council should cover the complete preceding year, so that the periods covered by the report and the accounts become identical.

The adoption of the report and accounts was moved by Dr. E. C. Walton (North Midland Centre), who also commented on the growth of membership and expressed appreciation of the efforts of the Council and the honorary secretary. Mr. S. G. Turner (South Wales Group), who seconded the resolution, likewise made cordial acknowledgment of the help received from the President and Council during the past session.

Street Lighting: Past, Present and Future

(Summary of an Address delivered by Mr. G. H. Wilson at the I.E.S. meeting in London on May 12, 1942)

There was a good muster of members to hear Mr. Wilson's address on May 12, which followed immediately after the I.E.S. annual meeting.

In opening his address Mr. Wilson remarked that it is possible at the present time to view the street lighting of the past with a certain detachment. Looking back, the period from about 1928 to 1938 is seen to be one of great technical progress. The erection at Sheffield of fifty street lighting installations, illustrating the eight classes of the British Standard Specification (first published in 1927) was an outstanding event at the beginning of the decade. This exhibition revealed the limitations of a classification based solely on illumination values—in fact, one quite minor installation gave remarkable evidence in favour of the growing opinion that road surface brightness was a factor of prime importance in street lighting.

The Study of Visibility

Mr. Wilson went on to explain how considerations of visibility had led to a study of the effects of road surface reflectivity on brightness distribution, and to a realisation of the importance of siting post positions so that a satisfactory distribution of brightness was obtained. This resulted in a departure from the traditional uniform spacing of posts and in such novel practices as the placing of the lighting units all on the outside of bends in the road.

Mr. G. H. Wilson showed lantern slides illustrating this idea of placing lamp posts on the outside of bends, and he also demonstrated—by the effective experiment with superimposed views from two lanterns—how it is possible to "fill up the gaps" and obtain approximately uniform road surface brightness by judicious siting of sources. The light distribution from many types of lantern was arranged so that the road reflection properties could be used to obtain this high and uniform brightness. This, however, led to another discovery—that there was often an appreciable amount of discomfort glare when these methods were adopted. This drawback could be to a great extent avoided by the so-called "cut-off" systems of lighting which, although inherently more costly, was found to have advantages where an adequate amount of light could be afforded.

Sodium and Mercury Lamps.

Another feature of this two-year period was the introduction and application to street lighting of two new light sources—the sodium and mercury vapour lamps. There were new problems arising from their peculiar line spectra, so different from that derived hitherto from incandescent sources of light. Towards the end of the period the new tubular lamps, operating through fluorescence, were first devised.

In the design of lighting units the advent of the discharge lamp caused a break from traditional form which resulted in sounder engineering designs. The appearance of the units and of the poles was in line with developments in industrial art in other spheres. With both gas and electric sources, optical systems of high precision became common. Discharge lamp units were eventually produced with an accurately controlled distribution so that glare could be reduced to a minimum whilst still utilising the hedpful reflection properties of the road surface.

M.O.T. Report

In 1934 the Minister of Transport appointed a committee to examine and report on street lighting, and in the recommendations of that committee a standard of lighting for traffic routes was laid down and suggestions for the placing of posts were made. This Report

was also instrumental in drawing attention to various difficulties in connection with the administration of street lighting—a problem which still remains.

After referring briefly to the present period of black-out lighting, which was largely an example of the control of light by absorption, Mr. Wilson concluded by reviewing post-war prospects. What, he asked, should be the direction taken by the street lighting of the future? The fluorescent lamp may find application, and there may be new sources. There may be new materials available for reflectors and refractors. But will the technical problems be the main ones? A review of the decade ending in 1938 suggests that our technical resources are enormous, and that technical problems are relatively easy of solution. This must be due in no small measure to the rigorous rejection of anything which is found not to work well and the enthusiastic search for something which will.

The Future of Street Lighting

It seems that the future of street lighting depends on the extent to which the scientific attitude of mind is employed in the application of the achievements of research. Perhaps something can be learned from another activity with which all the members of the community are concerned, that of town planning. Here Coventry sets an example with a new viewpoint arising from an analysis of the unsuccessful experiments of the past. Cannot the street lighting of the future be planned on an equally bold scale? It will entail co-operation between local authorities and commercial undertakings, users and suppliers, scientists and salesmen all having but one urge, the supply and installation of the most effective lighting for the purpose in hand.

Discussion

In the subsequent discussion the President and Dr. C. C. Paterson both agreed that, as Mr. Wilson's address had shown, we in this country had played a not unworthy part in connection with street lighting. The amount of research and experiment during the years preceding the war was remarkable. Dr. Paterson referred to the question of aesthetic appearance or, at least, unity of effect in large cities such as London. He also asked whether—in view of our experience during the war—"cost" was to continue to be the dominant factor. This point was later taken up by Mr. A. H. Owen, who speculated on what might be accomplished with such a sum as that raised in Manchester's Warship Week, and by Mr. P. Good, who urged that costs should be presented in proportion to other items, i.e., as a fraction of a penny per head of population per week rather than as a figure for so many thousands of pounds, which appeared unduly formidable.

Mr. E. J. Stewart discussed the maintenance of street lighting fittings—a difficult task at the present moment—and the need for consideration of this aspect in design. He pointed out the great opportunity for the embodiment of lighting in town-planning proposals. Mr. Colquhoun visualised the difficulties in finding funds for the restoration of street lighting immediately after the war, though, like others, he did not think that the present period of darkness would lead to public acquiescence in poor and ineffective lighting in the future.

Mr. Wilson, in summing up, drew some comfort from the reflection that the old ideas of finance had been "demolished somewhat"—possibly to the advantage of expenditure on public lighting in time to come.

Technical and Economical Aspects of Lighting for Production

We have received an account of the I.E.S. meeting in Newcastle on March 12, when a paper on the above subject was read by Mr. S. D. Lay. We mean to give a fuller account of this meeting in due course. Mr. Lay's paper covered a wide field, and quite a number of knotty points were raised in the discussion. Mr. S. I. Ellis presided.

An Illuminating Engineering Survey

(Specially contributed)

In what follows we present the final portion of a survey of the series of papers presented at the 1941 Convention of the American I.E.S. and published in *Illuminating Engineering* (Dec., 1941). A list of these papers appeared in our March issue, pp. 36-37.

(*Concluded from page 60, May issue.*)

Fluorescent Lighting

It is not surprising to find that no less than one-third of the papers presented at the Convention deal with the fluorescent lamp or its applications. The first of these papers, "High and Low Voltage Fluorescent Lamps," by Messrs. J. W. Marden and G. Meister, describes the chief differences between these two types of discharge lamps, a high-voltage lamp being defined as one operating at several hundred volts. The authors point out that for both types the light output depends on many factors, including the ambient temperature, the pressure of the inert gas in the tube, the type of electrode, and the thickness of the coating as well as its structure. They give extensive tables showing the effect of these variables, particularly the last-named, both on the initial light output and on the lumen maintenance. They conclude that it is possible to make high-voltage lamps with approximately the same initial output as low-voltage lamps and with similar maintenance.

"The Design of Reflectors for Fluorescent Lamps" was the subject of a paper by Prof. D. P. Severance, who took as his aims the reduction to a minimum of the light lost in the reflector, the achievement of a suitable distribution of illumination, and a satisfactory appearance of the fitting. The three reflector cross-sections, he considers, are (i.) the involute of a circle. (ii.) the circular arc, and (iii.) the logarithmic spiral. The treatment of the subject is entirely theoretical, but the mathematical results obtained are put in a form immediately useful to the designer. The paper deals exclusively with specularly reflecting surfaces, not with diffuse reflectors.

Problems in Photometry

"The Practical Photometry of Fluorescent Lamps and Reflectors" is dealt with by Mr. G. R. Baumgartner, who gives a very useful description of methods employed at Nela Park for the photometric measurement of these units. He points out that spherical photometers sufficiently large for the direct determination of the lumen output are not generally available so that another method must be adopted. Since the shape of the light distribution curve is very much the same for all standard fluorescent lamps from 18 in. to 60 in. in length (figures are given to support this statement), it is possible to use a kind of "reduction factor" and to obtain the lumens by multiplying by 9.25 the candle-power in a direction normal to the axis of the tube.

A troublesome complication in the photometry of these lamps, whether bare or mounted in reflectors, is the marked effect of temperature on the candle-power. The author gives curves showing the variation after starting up in the case of three different ratings mounted bare (a) for a single lamp and (b) for two lamps mounted side by side, 5 in. apart. The changes within the first ten minutes may amount to over 20 per cent. It will be clear that, since this is a temperature effect, it will be accentuated when the lamps are placed in reflectors and—an unfortunate limitation in photometry—it makes it impossible to measure lamps in any other than their normal burning position.

Various schemes are described for the photoelectric determination of the light distribution from units, either lamps alone or lamps in reflectors. It is assumed that the photocell will always be at a distance from the unit equal to at least five times the length of the unit. In certain cases a mirror is used to make the apparatus more compact.

Installation Problems

Of the papers concerned with various applications of fluorescent lamps, the first, by D. P. Caverly, is well described by its title, "The Application of High-Voltage Fluorescent Tubing to Lighting Problems." The author maintains that the high-voltage fluorescent tube has a valuable rôle to play in the lighting world, and he supports his claim by illustrated reference to a number of examples of applications covering a very wide range, from the theatre-restaurant to the machine shop and from the church to the department store. One fact he emphasises particularly is that efficiency characteristics are not the primary consideration in those applications for which high-voltage tubing is most suitable; it is in the decorative field that this source stands supreme. In the course of the discussion several speakers expressed the view that probably the

best solution of many a lighting problem would be found in a judicious combination of both low- and high-voltage fluorescent tubes.

The second "applications" paper, "Planning for Maintenance," by E. W. Beggs, deals with the problem of relamping a fluorescent tube installation. There is naturally very little difference between this and the relamping of an ordinary filament lamp installation, except as regards the relative ease with which the two types of source can be replaced. Early designs of fixtures for fluorescent lamps were very difficult to re-lamp, but this is not generally the case to-day. "Fixture" designers should use the now standard twist-turn type of socket or lampholder and should make it possible to re-lamp the fixture without tools.

A "mortality curve" for fluorescent lamps is given, and from this a curve of "replacement rate" is calculated. Starting with a completely new installation, the replacement rate rises from zero initially to a peak at about the average life of a lamp and thereafter the rate executes a damped oscillation about the value to which it finally settles permanently, when the life of the installation has become long compared with the average life of a lamp.

Lighting New Defence Factories

It appears that the use of fluorescent tubes for lighting the new defence factories being erected in the States at the present time has resulted in some very large installations. The lamps in a single factory are frequently numbered in tens of thousands, and a lengthy paper by Mr. G. J. Taylor, entitled "Lighting Large Factory Areas with Fluorescent Lamps," describes some of these installations and the problems associated with their design and operation. The factories are frequently single-storey buildings and the floor area of single rooms may reach half a million square feet. An illumination of 30-40 ft.c. in service is required, and so the design values are from 40-60 ft.c.

Recommendations are made for lighting large areas with moderate ceiling heights—and areas in which the sources must be mounted at considerable heights. In the former case, continuous-row lighting is often suitable. This consists of standard fluorescent industrial reflectors placed end to end in rows running completely across or along the room. Maintenance, it is pointed out, is a most important matter, and it is suggested that ten spare reflectors should be provided so that cleaning and relamping can be arranged on a "decanting" system. In an appendix the author gives some notes on illumination measurement, including a list of correction factors to be applied to photoelectric instruments on account of the colour of the light. In the discussion on this paper a good deal of criticism was levelled at the author's allowance for depreciation from new to service conditions, and it was pointed out that the obstruction of light due to machines, assembled fuselages, wings, etc., was often considerable. The use of the "coefficient of utilisation" method of calculating illumination was discussed by several speakers, and in general it seemed to be agreed that this method gave as reliable results with fluorescent lighting as when filament lamps were used.

Colour of Light-Sources

The paper on the "Interpretation of Spectral Distribution Data in Practical Colour Applications," by Messrs. R. L. Oetting and C. L. Amick, while of topical interest in connection with the use of fluorescent lamps, is quite general in its application to all souces of light. A special problem associated with the discharge tube is that of representing the energy in the lines which are superimposed on the continuous spectrum. The method used by the authors to plot the spectral distribution from a source, so that its significance from the point of view of colour rendering can be readily appreciated, is to divide the spectrum into nine bands covering different wavelength intervals. The energy in each of these bands is then shown by the height of a rectangle having the appropriate wave-length interval as base. The limits of these nine bands bear no relation to the limits of the eight bands now commonly used in this country for plotting the spectral energy distribution from different sources of light. In the discussion on the paper Mr. A. H. Taylor, who first proposed the particular nine bands used by the authors, emphasised that this method of exhibiting the data was not intended as a substitute for the complete spectral energy distribution curve but as an addition which would make it easier to interpret for practical colour applications.

Messrs. A. A. Brainerd and M. Denning, in a paper on "Improved Vision in Machine Tool Operations by Colour Contrast," describe an investigation carried out in an actual workshop to deter-

mine the effect of colour and brightness of surrounds on the ease with which certain machine processes can be performed. The two machines used, a small punch press and a power shear, were painted in various colours or combinations of colours and the workers' opinions were obtained. In addition, time studies were made on the shear. Certain conclusions are stated in the paper as the outcome of the investigation, but it is pointed out that this is merely a beginning in the wide field offered for study in connection with the use of colour and colour contrasts to obtain the best results from a given lighting system. Messrs. S. H. Eaton and R. G. Marchisio, in discussion, give details of an analogous series of tests carried out in their factory.

A discussion of the "Illumination Distribution from Linear Strip and Surface Sources" was presented by Messrs. E. H. Wakefield and C. McCord. The authors describe a model room in which various arrangements of strip sources can be simulated in the ceiling. They give the results of illumination measurements on the working plane both for black walls and floor and for a medium light decoration (walls 52 per cent., floor 25 per cent. reflection factor).

Lighting Drawing Offices

The lighting of drawing offices is dealt with in a lengthy paper by Messrs. W. G. Darley and L. S. Ickis, entitled "Lighting and Seeing in the Drafting Room." The authors take for study not only two positions of the drawing-board, viz., nearly horizontal and nearly vertical, but also a number of combinations of drawing materials, different drawing-board surfaces, and both indian ink lines and lines drawn with pencils of varying grades of hardness. Seven lighting systems are investigated, including indirect lighting, lighting from continuous trough reflectors, directional lighting, lighting from diffuse reflectors, and illumination of a tracing table by light transmitted from below. The paper describes the tests and gives the results of visibility measurements taken (a) with the Luckiesh-Moss visibility meter, and (b) by measuring the brightness and the brightness contrast and using these to compute a "visibility factor." The effect of shadows is given special consideration. No very definite conclusions are drawn as to the superiority of one lighting system over another, except that for tracing it is found that transmitted

light is much to be preferred to surface illumination.

The "New Policy" of publishing the Convention papers all together at an early date, instead of spreading them over the "Transactions" for a whole year is much to be commended. Under the old system it was often an exasperating experience to find that a paper which, from the abstract, was clearly of considerable importance in a particular line of study could not be read in full until nearly a twelvemonth after it had been presented.

Obituary

ALBERT FILLIOL

We observe with regret the obituary notice of M. A. Filliol, which appears in the Bulletin of the *Association Suisse des Electriciens*. Born in 1871, M. Filliol commenced his career in the service of the Electricity Department of Geneva, which, after experiences in Lausanne, he re-entered, becoming in turn engineer and director. He became keenly interested in lighting problems, taking part, from 1921 onwards, in gatherings of the International Commission on Illumination, of which he became honorary treasurer. He was also instrumental in founding the Swiss Illumination Committee, of which he became chairman.

Illuminating Engineering Nomenclature and Photometric Standards

A report under the above title has been issued by the Illuminating Engineering Society (U.S.A.) with the approval of the American Standards Association. The numbering conforms with the system adopted by that body, the definitions forming a group ("Illuminating Engineering") with sub-group numbers embodied for each of the eleven sections, which are as follows: Photometric Quantities; Radiation; Evaluation of Ultra-violet Radiation; Colour; Illuminants; Materials and Accessories modifying Distribution of Light; Classes and Characteristics of Illuminants; Photometric Standards and Tests; Aeronautic Lighting Units, Symbols, and Abbreviations; Equivalents and Conversion Factors.

Lighting in the Woollen and Worsted Industry

At the annual general meeting of the I.E.S., North Midland Centre, held at the College of Technology, Leeds, on May 4, the chairman, Mr. W. Hetherington, referred to the very satisfactory growth of the membership within the Centre during the 1941-42 session. The hon. secretary reported that fifty-one applications had been received during this period—forty-eight for Corporate membership, two for Associateship, and one for Student membership.

After the conclusion of the formal business a paper on "Lighting in the Woollen and Worsted Industry," by Messrs. T. C. Holdsworth, A.M.I.E.E. (Fellow), J. W. Howell, D.L.C., A.M.I.E.E. (Fellow), and J. H. Jackson, B.Sc., A.M.I.Mech.E. (Member), was read by Mr. Howell, one of the joint authors. About seventy members and visitors attended, including representatives from the textile industry.

In the first section of the paper the authors described the various processes involved in the production of both woollen and worsted yarn, and also the ensuing weaving and finishing processes resulting in the finished cloth. Flow charts were given, in which the processes are divided according to the visual effort required on the part of the operator.

The lighting requirements of the various operations were then reviewed in detail, and illumination levels suggested for the various groups of processes, according to the degree of visual perception required.

Finally, the authors considered the economics of textile lighting, quoting actual figures in the case of weaving. The paper was accompanied by a number of excellent lantern slides showing actual lighting installations in the woollen and worsted industry.

There was a good discussion, in which Mr. A. H. Owen (N.W. Centre), Dr. N. H. Chamberlain, Mr. Hobson, Mr. W. F. Pogson, Mr. M. C. Toner, and Mr. J. H. Mollan took part. The proceedings terminated with a vote of thanks to the authors, proposed by Mr. J. W. Adams and received with acclamation.

Members of the I.E.S. will learn with interest that Mr. J. S. Langlands, a member of the Scottish Centre, now on active service, has attained the rank of lieutenant-colonel.

Opal Glass Fittings

Predetermination of Performance

In his recent Presidential Address to the Society of Glass Technology Dr. S. English dealt with problems of interest not only to glass manufacturers but also to the lighting industry as a whole. In particular he discussed one problem —the predetermination of results from lighting fittings—to which the I.E.S. once gave a considerable amount of attention, though the researches then initiated did not yield all that had been hoped.

Dr. English is a past president of the Society and has taken much interest in this particular problem. He is also associated with Holophane, Ltd., and an expert on the design of prismatic glassware. On this occasion, however, he concentrated attention mainly on opal glass.

The address covered a wide ground. After reviewing early work done by the Society of Glass Technology on fundamental points connected with glass manufacture the lecturer turned to post-war requirements in illuminating glassware, analysing the qualities needed and stressing the importance of distinctive design.

One fundamental requirement in a lighting fitting is absence of glare. In this country a maximum brightness of five candles per sq. in. is considered satisfactory for indoor fittings, but a diffusing globe must be capable of reducing the brightness of the source to this value without too great sacrifice of light. It is therefore of importance to be able to predict the brightness likely to be attained and the loss of light involved. When opal glass is adopted this can be done by the aid of available data and with simple mathematics.

In the calculation one starts from the qualities of a flat sheet of opal glass. The factors of reflection, transmission, and absorption can be established for a particular variety of glass. The brightness of the incident and transmitting sides can then be calculated, assuming a certain size of lamp at a specified distance. From this stage it is a simple step to determine the brightness of the inner and outer surfaces of a sphere of similar glass having at its centre a lamp of known output in lumens. Allowance must, however, also be made for the effect of successive reflections of light within the walls of the sphere which furnish additions to the primary brightness, but this process can be dealt with by algebraic formulae and the final resultant brightness computed.

It is necessary to pay some consideration to certain practical circumstances which influence the result—for example, the fact that actual light sources do not give symmetrical distribution of light and the effects of neck openings or supplementary reflecting surfaces within the globe. Dr. English, however, showed that this could be done, and stated that laboratory tests had confirmed, with very fair accuracy, the results of his calculations. Although the calculation was applied to the simple case of a spherical globe the method can be extended to other forms.

In conclusion, Dr. English referred to the possibilities of rendering glassware attractive by producing artistic texture or surface finish.

The full address will appear shortly in the Journal of the Society of Glass Technology, and we commend it to the attention of illuminating engineers.

National Illumination Committee of Great Britain

(Affiliated to the International Commission on Illumination)

Constitution of the Committee on December 31st, 1941

NOMINATED BY THE CONTRIBUTING ASSOCIATIONS:—

Illuminating Engineering Society: A. W. BEUTTELL, DR. H. BUCKLEY, J. S. DOW, DR. S. ENGLISH, L. H. MCDERMOTT.

Institution of Electrical Engineers: LT.-COL. K. EDGCUMBE, P. GOOD, PROFESSOR J. T. MACGREGOR-MORRIS, DR. C. C. PATERSON, J. W. TOWNLEY.

Institution of Gas Engineers: W. J. A. BUTTERFIELD, J. E. DAVIS, G. DIXON, E. V. EVANS, S. LACEY.

NOMINATED BY THE CO-OPERATING ASSOCIATIONS:—

Admiralty: W. C. M. COUCH.

Air Ministry: C. B. COLLINS, W. J. F. WELLARD.

Association of Public Lighting Engineers: E. J. STEWART.

British Commercial Gas Association: D. CHANDLER.

British Electrical and Allied Manufacturers' Association: C. ROGERS.

British Electrical Development Association: A. C. CRAMB.

Department of Scientific and Industrial Research: (*National Physical Laboratory*) T. SMITH, DR. J. W. T. WALSH.

Electric Lamp Fittings Association: G. CAMPBELL, T. E. RITCHIE.

Electric Lamp Manufacturers' Association: W. J. JONES, C. W. SULLY.

Glass Manufacturers' Federation: E. J. C. BOWMAKER, G. MARCHAND.

Home Office: E. W. MURRAY.

Incorporated Municipal Electrical Association: E. J. JARVIS.

Industrial Health Research Board: H. C. WESTON.

Institution of Municipal and County Engineers: E. J. ELFORD.

Medical Research Council: Dr. H. HARTRIDGE.

Ministry of Health: A. SCOTT.

Ministry of Supply: COL. SILVESTER EVANS.

Ministry of Transport: E. S. PERRIN.

Ministry of Works and Buildings: G. SMITH.

National Gas Council: F. C. SMITH.

Post Office: SIR HENRY BASHFORD, H. W. FULCHER.

Railway Clearing House: M. G. BENNETT, A. CUNNINGTON.

Society of British Gas Industries: F. J. GOULD, R. J. ROGERS, CRAWFORD SUGG.

Society of Glass Technology: DR. B. P. DUDDING.

OFFICERS:

Chairman: LT.-COL. K. EDGCUMBE.

Vice-Chairmen: DR. C. C. PATERSON and W. J. A. BUTTERFIELD.

Hon. Treasurer: W. J. A. BUTTERFIELD, 66, Victoria-street, London, S.W.1.

Hon. Secretary: L. H. MCDERMOTT, The National Physical Laboratory, Teddington, Middlesex.

Representatives of Great Britain on the Executive Committee of the International Commission on Illumination:—

LT.-COL. K. EDGCUMBE and DR. H. BUCKLEY.

Annual Report for the Year 1941

(Presented at the Annual Meeting of the Committee held on Tuesday, March 10, 1942)

Owing to the continuation of the present emergency, the only meeting held during the past twelve months has been the statutory annual general meeting.

A small number of changes in the membership have occurred during the year. Mr. Crawford Sugg now represents the Society of British Gas Industries in place of Mr. A. R. McGibbon, while the representative of the War Office, Brigadier C. M. Simpson, has been succeeded by Colonel Silvester Evans, who now represents the Ministry of Supply. In order to preserve the identity of membership between the Illumination Industry Committee of the British Standards Institution and the National Committee, the Electric Lamp Fittings Association, represented by Mr. G. Campbell and Mr. T. E. Ritchie, has been admitted to membership; the British Electrical and Allied Manufacturers' Association is now represented by Mr. C. Rogers.

During the year the following British Standard Specifications have been issued: No. 941, dealing with electric lamp bulbs for automobiles, No. 942, entitled, "Formulae for calculating the intensities of lighthouse beams and beams from cognate projection apparatus," and No. 950, which is concerned with artificial daylight fittings for colour-matching purposes.

K. EDGCUMBE, *Chairman.*

Colour Vision and Colour Measurement

At the meeting of the Colour Group held on Wednesday, May 27, 1942, there was a demonstration by Mr. J. W. Perry (of Adam Hilger, Ltd.) of Dr. Houstoun's colour vision apparatus, followed by a paper by Miss Dorothy Tilleard, of the Paint Research Station, Teddington, on the relative merits of spectrophotometry and colorimetry as methods of colour measurement.

Dr. Houstoun's apparatus, which was described in the Proceedings of the Optical Convention for 1926, is designed for studying the hue discrimination of an observer. It exhibits the characteristics (and peculiarities, if any) of his colour vision by means of a map of contour lines on the colour triangle which show at a glance his ability to distinguish small differences of hue in all possible varieties of colour. Messrs. Adam Hilger, Ltd., have offered this apparatus on loan to the Colour Group for the use of its members as occasion arises.

In her paper, Miss Tilleard did not attempt to claim superiority for either colorimetry or spectrophotometry as a method of colour measurement or specification. She pointed out that each had its special field of application. For instance, where accurate standardisation is involved spectrophotometry is indispensable. On the other hand, a curve of spectral reflection or transmission factors does not give at all a clear indication of the colour of a material except to those who have had considerable experience in interpreting such curves. Further, the elaborate nature of the apparatus needed for precise spectrophotometry reacts, particularly in industrial laboratories, in favour of using the relatively simple trichromatic colorimeter for the many purposes for which a direct and simple description of the colour is all that is required.

Miss Tilleard described particular forms of trichromatic colorimeters, indicating the order of precision attainable with each, and she discussed various approximate methods of spectrophotometry based on the use of six or more filters.

An interesting discussion followed the presentation of this paper, members of the Group who had had practical experience of different methods of colour measurement giving their views as to the merits of a particular method for a particular job. The photographic method of spectrophotometry was mentioned, and Mr. Holmes (Chance Bros.) described the rapid grading of coloured glass by direct visual interpolation between samples which had already been measured accurately.

During the course of the meeting the chairman (Dr. W. D. Wright) announced that Messrs. Tintometer, Ltd., had offered to the Group, on loan, a demonstration model of the colour triangle.

Fluorescent Lighting Underground

It will be recalled that we referred some time ago to the lighting, with fluorescent lamps, of a vast underground factory engaged on national work.*

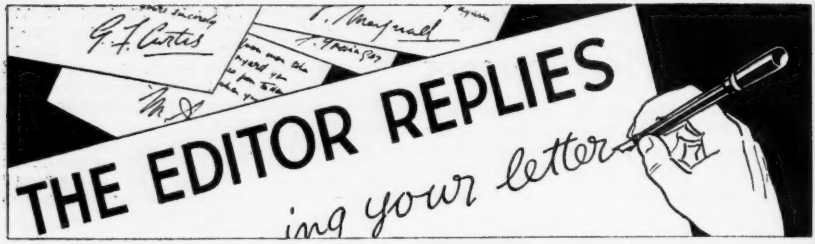
This particular factory is self-contained, complete with its own underground sub-station and telephone exchange.

An offshoot from one of the main galleries was of an ideal shape and size for conversion into a sub-station, and in it was installed the E.H.T. gear, transformers, and L.T. switch gear. Main paper cables for lighting and power were taken from the sub-station to a switch room built above the junction of four main galleries, and from this point ring sub-mains were taken above the ceiling to feed the various lighting and power boards distributed throughout the machine galleries.

Fluorescent lighting has been installed throughout, and the pleasant simulation of daylight makes it difficult to appreciate that the factory is actually underground. A maintained emergency lighting system consisting of batteries with a "Tungar" charger is also provided. Administrative offices built in one of the galleries are also provided with fluorescent lighting in the form of laylights. A former seepage pit has been turned into a control room. In this room is recorded the state of production throughout the works.

The whole scheme of electrification for this important undertaking was designed by engineers of the Edison Swan Electric Co., Ltd. Lighting fittings, lamps, "loud-speaker phones," "Tungar" emergency lighting equipment, batteries, paper and V.I.R. cables were supplied by the Edison Swan Electric Co., Ltd., and Edison Swan Cables, Ltd.

* LIGHT AND LIGHTING, March, 1942, page 34.



I have been asked to interpret the B.O.T. **Advertisement Lighting (Restriction) Order,** to which reference is made elsewhere (see p. 69). As usual, there seems to have been initially some apparent reluctance by the authorities to state precisely what they *did* mean. It reminds one a little of the remark by the convict in *Great Expectations*. ("Supposing that you are kindly allowed to go on living—which I haven't quite made up my mind about.") But I gather that the intention *is* to prohibit all advertisement and display lighting, not only in shop windows, but also in showcases on other premises, for example, in tube stations. On the other hand, lighting is permitted by the Order "for the purpose of serving the public"—in some instances perhaps a somewhat delicate distinction.

In reference to what has been said about **stairway lighting,** it is pointed out that the use of light-locks, coupled with the tendency to economy in the lighting of subways and staircases, is leading to a sort of **reversal** by day of the **black-out** peril by night—in fact, **another case of "black-in."** When one enters from the bright sunlight the eye is at first quite unable to make out surroundings in the gloom within. This impression is curiously heightened when the staircase is crowded with people so that one cannot see the comparatively brightly lighted background. This raises a problem which illuminating engineers do not seem to have ever attempted to tackle—how to light a crowd.

We have received from Mr. E. J. Stockwell some interesting diagrams showing the **distribution of illumination from a tubular fluorescent lamp.** They illustrate what, I think, is now becoming generally known, that the lines of equal illumination are in general oval in contour, though with a particular height of suspension circles may be produced, in the same manner as with a symmetrical source. This, however, is distinct from the **shadow effects** mentioned recently in these columns, which I gather are liable to arise whenever straight edges of things parallel to the tube are illuminated, and at all moderate heights of suspension.

The advantage attributed to a fluorescent source with the tube formed into the shape of a ring, instead of a straight line, lies not so much in the even distribution of light as in the fact that troublesome shadows are less likely to occur. In addition, a form of fitting more pleasing in general appearance might be secured.